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Instruction Manual

Model 135

SCALER - TIMER

Baird-Atomic, Inc.
Cambridge, Mass. USA



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I. GENERAL INFORMATION

A. Brief Description

The Model 135 combines in one instrument a scaler, a timer, and a high voltage power supply. Designed to accept signals from geiger, proportional, and scintillation detectors, the Model 135 provides enough power for the external preamplifier usually associated with detectors. When the B/A Programmer, Model RO-100, is attached to the Model 135, automatic readout of the scaler and timer on a printer is made possible.

B. Specifications

RESOLVING TIME: 5 μ sec, for pulse pairs

COUNT CAPACITY: 99,999 count on five all-electronic
Dekatron tubes

INPUT SENSITIVITY: 0.25 v negative

PULSE HEIGHT SELECTOR: Front panel discriminator
calibrated from 0.25 v to 10 volts with stability
of 2% per day

PRESET TIME INTERVALS: 0.1, 0.2, 0.6, 1.0, 2.0,
6.0, 10.0, 20.0, 60.0, 100.0, and ∞ minutes
with accuracy of $\pm 0.1\%$.

PRESET COUNT INTERVALS: 60, 100, 200, 600, 1K,
2K, 6K, 10K, 20K, 100K and ∞ with timer accuracy
of ± 0.01 min.

HIGH VOLTAGE SUPPLY: Electronically regulated and
variable from +500 to +2500 volts by a three turn
potentiometer.

Load Regulation: 1%, 0 to 0.25 ma at 2.5 kv
1%, 0 to 1.0 ma at 1 kv

Stability: 1% nominal per day

Line Regulation: 0.03% per volt between 105 and
125 volts

INPUT IMPEDANCE: 500,000 ohms, Geiger and signal.

CONTROLS: Power ON-OFF; High Voltage ON-OFF;
Preset Time; Preset Count; Discriminator; High
Voltage Adjust; Start; Stop; Reset

RECEPTACLES: Geiger Input MHV (JK-1)

Signal input BNC (JK-36)

High Voltage MHV (JK-1)

Preamplifier AN3102A-20-29S (JK-96)

Readout (JK-137)

REMOTE CONTROL: contains provision for remote
start, stop and reset

EXTERNAL POWER (all regulated): +250v DC at 30
ma, -150v dc at 0.5 ma
6.3v, 60 cycle ac, 2.5 amps

INPUT POWER: 115v AC, 60 cycles, at 1.2 amps

DIMENSIONS: 19" w x 8-3/4" h x 17" d

NET WEIGHT: 62 lbs.

SHIPPING WEIGHT: 74 lbs.

C. Brief Principle of Operation

Scaler and timer are started and stopped by a single control circuit. While the scaler is accepting, shaping, and counting input pulses, the timer is counting timing pulses at the rate of 100 per minute. A high voltage section powers the radioisotope detector, and a low voltage section supplies the necessary internal power as well as that necessary for a preamplifier.

II. INSTALLATION

The equipment consists of one self-contained unit. It may either be used in its own cabinet placed on a bench or table, or it may be mounted in a standard 19" rack. Since no side access is required, it can be placed next to a wall or between other units. There should be a back clearance behind the equipment sufficient to make connections. Baird-Atomic instruments have a unique "chimney" construction which reduces the operating temperatures by free-flow ventilation and permits ready access to all parts of the instrument. Therefore if mounting in a rack, be certain that there are no top-to-bottom obstructions to the free flow of air.

NOTE: the mercury switch in the control circuit is not designed to operate if the instrument is tipped more than $\pm 30^\circ$ from a horizontal axis.

III. OPERATION

Table III-1: Switches and Knobs

Control	Schematic	Type	Function
POWER ON-OFF	S401	DPDT toggle switch	Applies AC to transformer T401
RESET	S106	toggle	Removes ground connection from all guides and cathodes except the "0" ones.
START	S105	Push button	Connects pulses from chopper to V109.
STOP	S104	Push button	Raises cathode of V108 to ground to stop flip-flop
PRESET Time	S103	12-pos rotary	Routes pulse from selected cathode of glow tube in timer to Stop circuit, V108
PRESET Count	S102	12-pos rotary	Routes pulse from selected cathode of glow tube in scaler to Stop circuit, V108
High Voltage ON-OFF	S301	DPDT toggle switch	Applies B+ power to RF section and B- as reference voltage
High Voltage adjust	R306	50K pot.	Controls reference of DC amplifier, hence amount of feedback to RF oscillator screen grid, hence size of HV output.
"Pulse Height" adjust	R289	15K	Varies bias of V101A to change minimum acceptance level for input pulses.

Table III-2: Connectors

Title	Schematic Designation	Type and B/A Designation	Function
High Voltage	J301	MHV (JK-1)	Connects HV to scintillation detector
"Geiger"	J302	MHV (JK-1)	Connects HV to geiger detector and introduces signal from detector
"Signal"	J303	BNC (JK-36)	Introduces signal from detector (not used for most detectors)
"Preamp"	J304	AN3102A-20-29S (JK-31)	Introduces a signal from preamp and supplies filament and B+ power to preamp.
	J101	17-contact female (JK-96)	Provides certain control functions to readout and sample changer, has jumper connection between pins K and G which should be removed when M135 is remotely controlled.
	J102	24-contact female (JK-137)	Connects output cathodes to switch in readout which blocks pulse transfer during readout. Mating plug with jumpers supplied; to be removed when connected with Readout.

Connections: The following list indicates the proper B/A cables with which to connect the Model 135 to compatible B/A instruments:

Model	212	5 & 9
	215	5
	231	1 & 2
	245	5
	250	1 & 9
	510	5
	810B	1 & 2
	812B	HV and/or Preamp Cable Built Into Probe
	815B	HV
	818B	HV
	821C	14
	822B	15
	845	2
	870	HV and/or Preamp Cable Built Into Probe.

For interconnections with the RO-100 Readout and Model 755 Sample Changer see the respective manuals.

Operation: (If unfamiliar with radioisotope counting techniques, consult some introductory book such as B/A's Scintillation Spectrometry (available on request).

After all proper connections have been made:

- (1) Turn POWER switch on.
- (2) With the HIGH VOLTAGE knob turned fully counter-clockwise, turn the HIGH VOLTAGE on. Wait for click of time delay relay before proceeding to next step.
- (3) Adjust HIGH VOLTAGE to desired setting as the requirements of the detector dictate. To meet drift specification, permit the instrument to warm up for 10 minute at the desired voltage setting.

(4) Press RESET toggle switch to set the glow tubes at zero.

(5) To test the action of the Model 135 on PRESET COUNT, set the scaler PRESET on some count total and the timer knob on TEST. Press START button. If instrument is operating correctly, counting and timing will continue until the desired count total is reached.

(6) To test the action of the Model 135 on PRESET TIME, set the timer PRESET on some time total and the scaler knob on TEST. Press START button. If instrument is operating correctly, counting and timing will continue until the desired time total is reached. Since the test signal operates at a frequency of 60 cps, setting the timer at one minute ought to produce a total of about 3600 counts on the scaler.

(7) Set the PULSE HEIGHT control. This is a "discriminator" whose function is to prevent pulses below a preselected pulse height from being counted. For most purposes, this control will be used to prevent undesired noise pulses from being counted. With no radioisotope source in the detector, set the PULSE HEIGHT control starting from the CCW, minimum voltage, position until no counts are being registered on the scaler. This control can also be used, of course, to plot an integral spectrum.

(8) The Model 135 has an "override" feature. This means that it will count and time until either the scaler or timer total, preset with its knob, is reached. Thus a weak sample will be counted for some fairly sensible amount of time, rather than being counted for an indefinite period regulated by a preset count setting. If you do not wish the override feature to be operative, set the proper knob at the ∞ position.

(9) In reading the timer glow tubes, note that the large dot on the front panel between the second and third tubes signifies a decimal point. The timer registers in minutes and tenths and hundredths of minutes.

(10) For a very precise "60 ~ test," disconnect any input signal source.

(11) Input pulses more than 20 times the threshold setting of the discriminator should be avoided. Thus, if the PULSE HEIGHT Control is set at 0.5V, input pulses should not exceed 10V.

IV CIRCUIT DESCRIPTION

The Model 135 contains four basic sub-sections:

- (1) A scaler
- (2) A timer
- (3) A high voltage power supply
- (4) A low voltage power supply.

In addition, there is a circuit to control the scaler by the timer and the timer by the scaler. We will discuss each of these in turn.

Scaler. Signals from an amplifier or analyzer which exceed 0.25V negative are amplified by V101A and sent to V102, a Schmitt trigger circuit. (V101B is a control tube discussed below.) The pulse height acceptance level at the input to V101A is adjusted by R289, which changes the gain. V102A is normally off and V102B is normally on. A positive signal from V101A triggers the Schmitt circuit to go through a cycle and produce a negative signal to the first flip-flop, V104, of the fast decade scaling circuit. Triggering of the binary scaling pair forming the input stage of the four cascaded stages is effected through two triggering diodes (CR103 and 105). Each of the four binary scaling pairs consists of two resistance-coupled triode amplifiers having DC intercoupling to provide a circuit which exhibits two stable states of equilibrium. The circuit constants are such that when one triode is conducting, the grid of the other triode is held below cutoff by the DC coupling between the two sections. Conversely, the grid of the conducting triode is held firmly on by the plate circuit of the non-conducting triode. Thus the circuit will remain in this condition of equilibrium until an external trigger causes it to flip over to its other equilibrium state. It will be readily seen that four such binary scaling pairs cascaded could produce one output pulse for every sixteen input pulses. However, by means

of appropriate coupling connections and a feedback loop, the system is caused to reset to its zero count position after each tenth count. To provide a direct and uniform system of indication utilizing a Dekatron-like register tube, the resistor matrix R114 to R143 is employed to connect the decade to its indicator V103. This is accomplished by utilizing the plate potentials of all eight triodes of the decade in such a manner as to provide a unique voltage condition for each of the 10 states of the decade, such that one of the 10 cathodes of V103 glows for each of the 10 corresponding states of the decade

The remaining scaling stages utilize the Dekatron cold cathode tube for scaling as well as visual representation of the count. These gas-filled tubes have a visible cathode glow on one of a set of ten cathodes arranged around a central common anode. Two sets of interconnected guide-electrodes physically spaced between each cathode serve to transfer the cathode glow from one cathode to the next. Normally, the discharge in the tube takes place between a cathode at ground potential and the anode at about + 200V. The negative pulse from V114A is coupled to the first guide electrode of V110, pin 5. This causes the discharge to occur between the 1st guide electrode and the anode since the voltage difference is sufficiently greater than that between the second guide and anode or between cathode and anode. The same pulse is coupled through an RC integrating network to the 2nd guides. This network causes the voltage on guide two to follow that on guide one, until a point is reached when the voltage on guide two is considerably more negative than the voltage on guide one. The glow therefore transfers to guide two. When the input pulse disappears, the guides return to their normal +40 volt bias and the discharge can once again occur between one of the cathodes and the anode. Since there are already ions or electrons present in

the vicinity, the discharge takes place to the nearest cathode rather than to one at a greater distance. Thus for every input pulse, the glow begins on one cathode, transfers clockwise to the first guide electrode, to the second guide electrode, and then to the next cathode. In short, for every pulse in, the tube registers one count. After nine pulses have driven the glow to cathode #9, the tenth pulse produces a discharge between the output cathode (pin #5) and the anode.

The positive pulse from the output cathode of V110 is coupled to the driver tube of the next scaling stage, V114B and V111.

Here again a negative pulse at the plate causes the gas discharge to occur between the first guide and anode. C135 and R216 integrate this pulse to cause the glow to transfer to the second guide, etc.

Timer. The timer is a bank of four glow tubes which receive signals from the chopper at a rate of 100 cpm. Decade accumulation is the same as in the scaler section.

Control Circuit: (a) Chopper. R148, 146, 145, and 147 constitute a voltage divider string. C106 holds R148 at a constant voltage. M101 is a synchronous 100 rpm motor with a magnet which opens S101 once per revolution, shorting out R145. Therefore during the time R145 is shorted by the mercury switch, the voltage across R146 rises about 20V. These positive pulses are routed to V109 and to the timer glow tube register when the gate circuit described below, is open.

(b) Start-Stop Circuit The positive pulses taken from R146 are differentiated by C128 and R196 when the start switch is pressed, and the positive-going leading edge brings into conduction V109 (right hand section). V108 (rh) and V109 (lh) constitute a flip-flop with V108 (rh) normally conducting and V109 (lh) cut off. The negative signal from V109 (rh) reverses this condition, turning on V109 (lh) and turning off V108 (rh). A negative signal from V108 (rh) is coupled to V101 grid.

c. Control Tube. Under quiescent conditions V101 (rh) is conducting. Note that the screen grid of V102 (lh) is DC coupled to the plate of V101. Tube parameters are selected so that the plate voltage of V101 (rh) in conduction is too low to permit conduction of V102 (lh). Also, with V101 (rh) conducting, the positive pulses produced by the chopper (described above) are gated off from the timer glow tubes by a conduction path from R144 through CR101 to C101. However when the start circuit is operative and a negative pulse from V108 (lh) cuts off V101 (rh): (1) the screen grid of V102 (lh) rises to permit conduction and hence passage of pulses through the scaler and (2) the cathode of CR101 has a higher voltage than its anode, and thus opens the conduction path, routing timing pulses to the timer glow tubes. Thus scaler and timer are initiated simultaneously.

Stopping the instrument may be accomplished by any one of three signals. Pressing the STOP button will raise the grid of V108 (lh) and hence bring V108 back into conduction by initiating a cycle of the flip-flop. Positive signals from timer and glow tube output cathodes at the various preset times and counts will perform the same function.

High Voltage Supply - The HV supply consists of an RF oscillator with filters and a DC amplifier for regulation. The oscillator is of the plate-tuned variety and operates at approximately 500 kcps. The RF output is rectified by V 302 and filtered. One-twentieth of the HV output variation is applied to the DC amplifier V303 and V304, which, in turn, regulates the screen grid potential of the oscillator tube (V 301). This potential varies from 20 V to 85V according to the HV output setting.

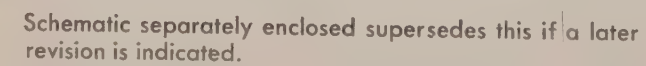
Assuming a variation in the positive direction of the HV, this is coupled to the grid of V304, amplified and inverted in polarity when applied to V303 (rh) where a voltage change in the negative direction is taken off the cathode and applied to the screen of the RF oscillator V301. Its oscillations diminish in amplitude and the HV is held constant. (Similarly for negative variations.) There is an AC stabilizing feedback loop consisting of C307 and R312 for reduction of ripple and fast recovery from load transients.

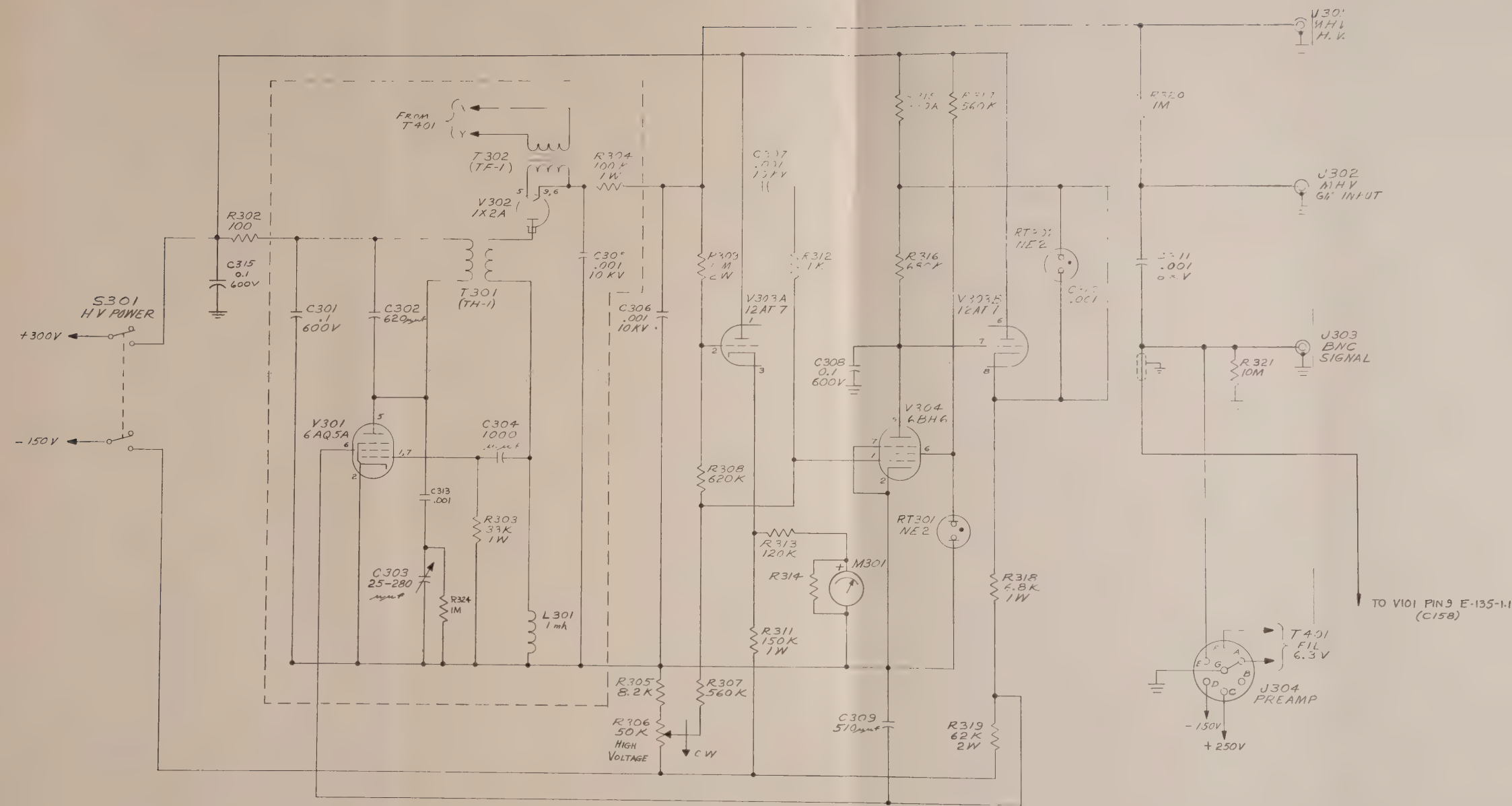
High Voltage adjustment is accomplished by R306 and R300, which establish the reference point. Owing to the high loop gain, the grid of V304 stays at -1.8 V. Therefore, the HV output assumes a potential equal to 20 times the potential of the arm of R306. R314 is a meter shunt selected to accomplish 2% meter calibration.

Low Voltage Power Supply Two methods are used to obtain voltage regulation. M135 has a Sola regulating transformer, and electronic regulation is also employed. Solid state diodes are used throughout for rectification. The +470 V unregulated is used for the glow tubes. The +300 V and +250 V are separately electronically regulated using the conventional series regulating technique.

A -150 V supply is clamped by an OA2 voltage regulating tube while the -160 V and -170 V are unregulated. The various filament voltages are obtained as seen on 135 - 1 3 schematic.

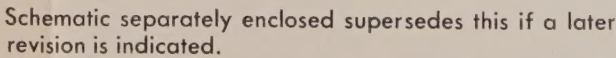
The test signal consists of positive spikes at 60 cps. It is obtained by half-wave rectification with CR56 and sharpening through a network consisting of C 410, VR 404, and R 425. Note that the signal is applied through C411 and the PRESET switches to the grid of V102 (lh)





NOTE:

Schematic separately enclosed supersedes this if a later revision is indicated.



WARRANTY

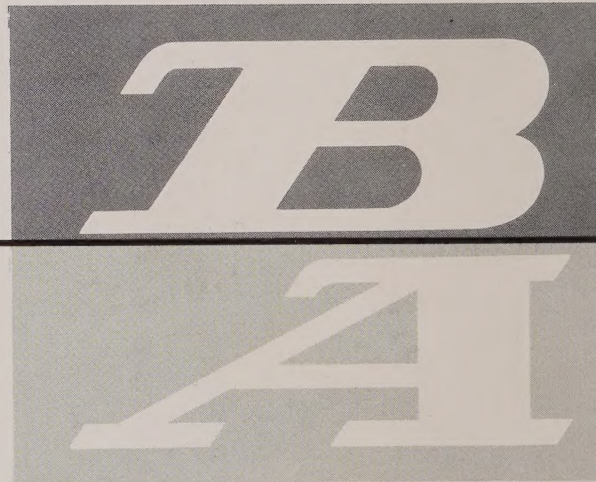
Baird-Atomic, Inc. (the "Company"), warrants this equipment for a period of 1 year from the date of shipment as follows: it warrants that all equipment of its manufacture is free from defects in material and workmanship at the time of shipment. If within 1 year of shipment any equipment of the Company's manufacture develops defects in material or workmanship under normal conditions of operation, the buyer of the equipment may return it to the Company within 30 days of such failure, for repairs at the expense of the Company, including the expense of shipment, or in the case of any defective part may return such part to the Company which will repair or replace the same at its expense, including the cost of shipment. A further warranty of 1 year on the same terms shall be applicable to any part so repaired or replaced. Except for Dekatron glow tubes, this warranty does not extend to stock components not manufactured by the Company.

The Company shall not be liable for damage or destruction of instruments during delivery or caused by other than employees of Baird-Atomic, Inc.; in any event, liability shall not exceed the cost of replacement of defective parts upon prompt notification of such defect.

For return of equipment or any part thereof under the terms of the foregoing warranty a letter should be forwarded to Baird-Atomic, Inc., Attention: Sales Service Department, 33 University Road, Cambridge 38, Massachusetts. It should state owner's name and address; model and serial number of the equipment; the order number, under which it was purchased; the date of failure and a description of the circumstances surrounding same. Upon receipt of such information, shipping instructions for return of equipment or parts thereof will be forwarded promptly.

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